The Journal

OF THE AMERICAN SOCIETY OF SAFETY ENGINEERS

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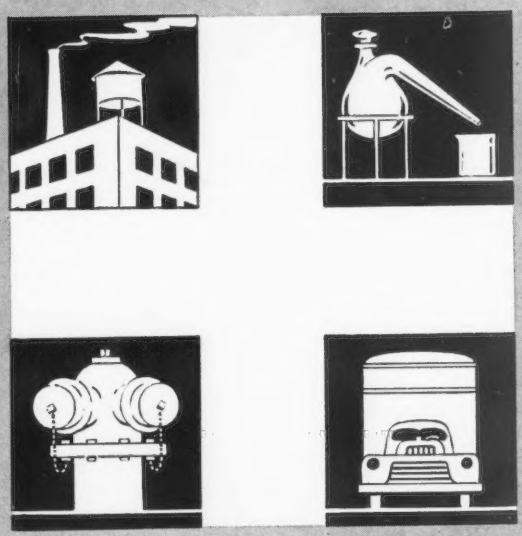

MAY, 1959

Volume IV Number 2

Harvard University Group Studies Accident Causes

■ Underlying causes of fatal traffic accidents is the subject of an exhaustive five year study recently launched by the Department of Legal Medicine at Harvard Medical School. This study, certainly one of the most important research projects ever attempted in the traffic safety field, will include both "on the scene" and post-accident studies by automotive and traffic engineers, psychologists, psychiatrists, social workers, attorneys, pathologists and others.

Codirector of this project is Alfred L. Moseley, research associate at Harvard and the author of "Motives Leading to Safe and Unsafe Acts," which appears on pages 18-24 of this *Journal* issue. This article, which covers some of the psychological principles and some of the results of preliminary investigations leading up to the present Harvard study, was presented, in part, by the author in a Society-sponsored session at the 1958 National Safety Congress.

More complete background on the Harvard study will be presented in a coming issue of the *Journal*. We also hope to publish progress reports, from time to time, on this vital project.

Two other articles in this *Journal* issue are based on 1958 Congress papers from Society-sponsored sessions, "An Engineering Approach to Safety in Materials Handling," by Walter J. Byrne, and "Methods and Procedures in a Multi-Plant Safety Program," by James W. Tysse. These three articles serve as an indication of the breadth of subject matter covered each year in these Society sessions of the Congress.—Editor

AMERICAN SOCIETY OF SAFETY ENGINEERS

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OUR PRESIDENT SPEAKS ON SAFETY

ONE OF THE MOST IMPORTANT, if not the most important, factor in accident prevention work is attitude. If the majority of people in any segment of the population really desires safety and wants it enough to place accident prevention above other desires, drastic reductions can be made in both frequency and severity.

Let's take, for example, the population segment represented by the people in a particular plant. If the majority is sincerely interested in reducing accidents, then accidents will be reduced. We safety engineers use all kinds of methods in attempting to sell accident prevention to this majority. Top management interest and backing, responsibility of foremen and education of employes are only a few of the items that are useful in this work. By whatever means we accomplish our purpose, if we finally can sell the majority of the group so that these people become interested and active, then accident prevention efforts will show marked results.

The highway safety picture is not different, fundamentally. It is much more difficult, however, to reach a majority of the very great number of people who use the highways. Again, safety engineers use many various devices in attempting to sell the majority of this segment of the population. Because the audience is so much larger and operations are not as concentrated, traffic safety efforts show much less spectacular results than do accident control programs in industrial situations.

We can see signs of improvement when we are able to reach a small group of this large population segment, the driving public. The excellent improvements realized through driver education in high schools is a good example of such success. Statistics show that, as a group, students who have received proper driver education have a highway accident frequency only half as great as that of the group of students which has not had the benefit of such training. And the significant difference between these two groups is simply that the former has received education in proper attitudes toward safety.

Many commercial vehicle drivers have produced an excellent record because, here again, a small segment of the driving public has been reached with safety education and the majority of this segment has acquired the proper attitude, sincerely believing that accident prevention is important.

Our real problem, as safety engineers, is to reach the majority of that large part of our population which uses our highways. These people must be reached by a variety of methods, but all directed toward helping them develop the right safety attitudes concerning highway accidents.

When enforcement officers receive proper backing, when it becomes politically expedient to eliminate ticket fixing and when the majority of highway users place traffic safety above conflicting personal interests, we will see a considerable reduction in highway accidents. This means that the individual motor vehicle operator must place the rights of others above his own personal rights such as selecting the speed of the car, traveling and driving irrespective of others and similar rights. When the majority of drivers has the proper attitude, highway accidents will be reduced.

It is up to us, as safety engineers, to use all proper means and methods available to help bring about the proper attitude among all segments of the population. This attitude must prevail at work, in the home and on the highway.

Donald G. Vaughan

DONALD G. VAUGHAN, PRESIDENT
AMERICAN SOCIETY OF SAFETY ENGINEERS

motives LEADING TO SAF

from infancy, experiences help shape actions; research shows unsafe acts sometimes result from overt or covert desires to hurt or be hurt, to expiate guilt, to die or to realize a secondary gain

BY ALFRED L. MOSELEY

IN INTERVIEWING ENGINEERS for a specialized piece of work, a broken machine component was introduced with the question, "How was this made?" One said a bar was drilled and rounded. Another said it was a seamless tube. A third said it was a piece of bar stock that had been rolled and welded. The latter was correct.

It becomes clear that, to understand why it failed, it is necessary also to understand how it came to be. This is essentially why a new approach to the situation in relation to accidents is important. *How do motives develop during life and what emerging forms of expression are conductive to accident involvment?*

MOTIVE DEVELOPMENT STARTS EARLY

The term "security" in business and industry basically has to do with money. In the field of personality, it has to do with status. But the meaning of money and the meaning of status are really very similar. To develop a feeling of security in a child is to develop a feeling of being wanted and loved. It means protecting a child from falls, spoiled food, disease. It means warmth, mother noises, cuddling. It means play at the child's level of development and restful sleep.

When protection is viewed in the system of developing the child's security, it becomes part and parcel of the way the family does things. It influences how everyone who comes into the household acts, and what structures and objects are available to the child. If you want to be sure about what the baby sitter feeds the infant, then you prepare the bottles before the sitter arrives. Thus, you run little risk that some milky white cosmetic lotion will find its way through a nipple to the baby's tummy. If you wish to be sure that the child's crying doesn't bring down the wrath of the whole household, you have the pediatrician have a look to find what is wrong, not waiting until the matter is a serious one.

CRYING INFANT RESPONDS TO HELP

From the birth cry until the child attains enough maturity to handle minor injuries without difficulty, the noises emitted while ill, fatigued, hungry or needing exercise may be a problem. Many people cannot stand hearing an infant cry. Some have enough sense to investigate when their nerves begin to be frayed. But some adults, and adolescents as well, are so upset by a crying infant that they lose control completely and fail to act intelligently to solve the problem. The medical examiner can tell of autopsies of infants whose deaths occurred under circum-

stances of sustained crying, with the manner of death related to crushing head injury or asphyxia. The crying turned out to be the result of ear infections, which no one suspected and which no physician found—for none was called to assist.

When the child cries at mealtime, the mother usually will recognize the hunger, unless she is feeble minded. When the infant's fatigue goes beyond a certain point, sleep will follow as a natural course unless something else is wrong. In some illness situations, the temperature tipoff that the child is sick—has an infection—does not develop early enough to give the impression that a pediatrician is needed. Mothers get very good at observing the infants, and usually can tell very quickly if something is basically wrong. For example, in poisoning cases, about 85 per cent of the instances

AND UNSAFE ACTS

are discovered in the first 15 minutes. From this fact you can deduce three things: that the mother knew something was available to the infant, that the mother observed the child frequently and that the child's appearance or behavior was noticeably changed.

What the parent does for the child in these situations has much to do with the child's security. Pain may continue or may be modified to discomfort level but, if the parent is trying to do something to help, the infant is aware of it and the love need is filled.

CHILD LEARNS AS MOVEMENT DEVELOPS

Reach and Grasp—The ability to reach and grasp develops before some of the other basic types of motion a person makes. It is directly involved in the capacity to take things by mouth. This is the basic ability that leads the child to taste and, often, to try to swallow everything in sight. The basic motive is, of course, food taking, aided by the need to have contact by mouth with anything that can reach the mouth. During the first two or three years of life, it can never safely be assumed that this need has been filled. Taste seems to have nothing to do with the propensity of the child to taste and to swallow.

Crawling—With the advent of crawling, the horizons are expanded. Anything that can be reached or pushed, or that will fall, becomes dangerous. Any open place, stairway, storage unit or temporary depository, any locus of work in progress, becomes a site at which trouble may develop. These hazards remain essentially the same throughout life, although the capacity to perceive them and protect oneself from them changes.

Walking—When the child learns to walk, his horizons are expanded greatly. His capacity to get from one place to another is enhanced and he may move around with considerably greater speed than before. Here one sees the root of one of the basic protective principles.

Let us say, for the purpose of argument, that it is impossible to keep a person from getting into a given container, compartment or place. If you can make it harder for him to get in, then it takes more time to do it and you increase the probability that some person in a control position will observe what is happening. This is no different from the policy of trying to prevent a theft from taking place for ten minutes, figuring that if it is not completed more quickly than that, it may not take place at all. There are many parents who follow such a principle but who, unfortunately, sometimes do not know hazards are present. For instance, parents are not always informed by the manufacturer as to the toxicity of the product.

It does not take any leap of the imagination to agree that when a child learns to walk, he also is going to fall. What you want him to do is walk; what you do not want him to do is fall. It would appear that the simplest way to manage the child's development would be to base the learning procedures on the facts that life offers. People walk for most or all of their years and people fall at intervals during most or all of their years. If you are teaching a child to walk, should you not also be teaching him to fall? His normal course of development will bring him to the erect posture and a two-footed gait. Teaching him to fall will provide him with the skill to protect himself when he falls. (See Figures 1 and 2.) As a matter of simple fact, you can do a lot more actual teaching on the matter of falling than you can on the matter of walking. Providing

Alfred L. Moseley, research associate, Department of Legal Medicine, Harvard, is codirector of the university's recently launched five year study on traffic accident causes. With an AM in psychology, he has nine years' experience in accident analysis (including five years' work with Dr. Ross McFarland), has taught in colleges and published 60 research papers.

a skill to use in meeting the situations of danger in life is one of the most basic activities to be carried out in child development.

CHILDISH WISHES NEED CHANNELING

Along with these stages in development, meaningful noises and speech gradually appear. The child learns to avoid the spoon and then to express likes and dislikes. A very important period in the development of his motives has been reached. The psychology of the mother is very important.

Interview data, from mothers whose children have been injured or poisoned in accidents, suggests that the mothers take two stands: (1) what the child wishes for is all right for him to have or to do—the wish is to be approved or granted immediately; (2) it is the mother's prerogative to do as she wishes with her child. But the mother must learn that the child needs to be taught how to wish for something that is reasonable. She must learn to judge the meaning of the child's wishes and his capacity to wish for the reasonable.

The fact that the two year old child can climb up on the open oven door does not mean that he should be permitted to do so. This principle applies quite as much if the door and oven are cold as it would if the oven were hot. It is certain that at some time the oven will be hot. The child may carry a blanket in his hand that will act as insulation but, if he drops it, he will be vulnerable. Abstracting the principle, the hazard is always there: the gun is always loaded; the tea kettle is always hot; mother's sweet-smelling perfume is always poisonous. The child must learn that his wish to occupy, hold, pull, eat, drink or play with something hazardous is not a relevant criterion of whether he should have it.

YOUTH TESTS REALITY AND AUTHORITY

A great deal of activity in early life is concerned with getting acquainted with the real world. It must be looked at, manipulated and tasted. Out of this persistent attempt to consume everything in sight come some concepts of the world and its simple chemistry, physics and human relations. When the child has differentiated among the things which are liked or disliked, he learns that he can evoke a different reaction from his parents if he refuses something. While the initial attempts are real enough, in the sense this spoonful is not wanted, he "tastes" the use of the tactic in other areas, now refusing something for the effect that the refusal creates.

When this pattern of refusal for effect is understood by the child, he may use the technique in testing reality. The matter of reality testing has to do with standards, setting limits and penalties. *Standards* refers to the positive controls—"This I want you to do; this behavior I reward." *Setting limits* has to do with negative controls—"This you may not do; if you do this, I will punish you." What happens in reality testing determines important personality issues for the whole of adult life. Do you remember ever having had the experience, as a child, of having a lad your age draw a line across the gravel walk and threaten, "Spit across this line and I'll knock your block off"? Let's say that you did accept the challenge and that he didn't strike out at you. He is automatically nobody.

This parallels very neatly the type of thing that happens when the mother or father makes a rule, establishes a penalty, announces both and does nothing when the rule is broken. The parent fails to see that the child feels the need of being protected from his own impulses by drawing on his parents' strength. Thus it is seen that, when the child is doing what may be called reality testing, he is in fact asking for control. The best psychology in dealing with the request for control is to give it—and do it now! If you do, the child's security is enhanced because he knows that he can depend on you to guide him and interpret the requirements that the real world places on him.

When difficulties develop between the mother and father, the unexpressed affection is channeled in quantity, and in its qualitative component as well, to the child. Obviously loving a child too much, or in the wrong way, is very damaging to the

Figure 1— To protect onself in a forward fall, use knees, lower limbs and extended arms to break the fall. Head and pelvis are high to prevent injury.

child. When the love process in the family is amiss, the personality roots which develop into revolt against the authority figure in the family, usually the father, are established. Once having developed, it is quite easy to generalize the revolt, or "pass it around," to all other authority figures. Soon it includes school teachers, other parents, officers of the law and business people. The tendency to revolt against authority is one of the best predictors of the likelihood of being involved in accidents.

If the parental love situation is of sufficient quality and quantity to meet the need of parents for each other, then there is not the drive to be stupidly permissive in controlling the children. This situation fosters respect for authority, based on the fact that it is "OK" with mother for junior to be like father and it is "OK" with father for daughter to be like mother. The family standards then mean that mother reinforces father's authority and vice versa. This is the normal setting for sound character development. *It is the normal development that safe activities will be intrinsic within this setting.* Adequate adaptation to authority, to laws of nature and to situations and machines that embody them is a perfectly natural byproduct of this type of family setting.

The indulgent parent who loves the child unwisely and too much retards the child's emotional development and renders him emotionally incompetent far into the years of adulthood. Not only accidents but also such problems as alcoholism are the byproducts of this retardation. The accident problem is implicit in alcoholism due to the impairment of cortical controls in the brain, interference with motor function and lapse of insight. The recovery period also demonstrates guilt and the hangover. People do strange things under the influence of either of these reactions during the recovery period.

ERROR SPECTRUM SHOWS ACCIDENT RANGE

It is necessary to make something of a jump to adult life here due to the limitations of space. Identifying negative motives is, at this stage, a positive step in controlling them. The continuum of errors in which we are interested has, at one end of its spectrum (see Figure 3), the extreme accuracy of the skilled worker who, by deliberate intent, makes accurate moves and produces a quality product. Slight blemishes are near neighbors, then errors. Accompanying errors are time delays and the production of seconds and rejects. The next point in this spectrum is errors of such magnitude as to damage equipment. The next is personal injury. The next is the production of injury to a fatal degree. There is one more qualitative component in this spectrum—the deliberate act which produces damage, injury and death. It most often is hidden, because an accident generally is defined as a chance event; chance and deliberation as sources of destruction are incompatible bedfellows.

LIABILITY SPECTRUM IDENTIFIES SOURCE

In order to see why motives are expressed in an error spectrum, it is useful to look behind it to a basic source or mainspring. Let us call this the liability spectrum and identify its two extremes, love and hate. These are present in any person at the same time and may be simultaneously expressed. For instance, you may say to your wife, "That is a lovely hat. It makes you look ten years younger. But I don't think you can afford to age ten years every time you take off your hat." Or it may be illustrated by the story of Wilbur Meisner, who said he was once stranded in Spokane without funds and wired his mother for 20 dollars. In a few hours came the reply, "I didn't get your telegram." But love and hate are expressed both outwardly and inwardly and have very different consequences. The complete outward expression of hatred leads to murder, whereas hostility turned inward leads to depression and suicide.

The strength of its outward or inward expression is determined in part by what its results prove to be. When the worker pays no attention to orders given by the night superintendent, the supervisor may beat his fist againt the wall or have a tantrum equivalent to that of a small child. He literally hates himself because he cannot control his workers. The frustra-

Figure 2— To protect oneself in backward fall, use feet, shoulders and slapping motion with hands to break the fall. Head and pelvis are high to prevent injury.

tion builds upon itself and it becomes more extreme, for each tantrum not only embodies the problem of the immediate situation but also embodies the residuals of the earlier ones. If the frustrated person is inclined to pout, then retreat and depression follow in due course of time. Depression is a natural setting in which to injure oneself.

FACTORS INFLUENCE EMOTIONAL EXPRESSION

Some other factors influence the modes of expression in the love-hate spectrum. These factors include the sadistic-masochistic component, guilt, wish to die and secondary gain.

Sadistic-Masochistic Component—The sadistic-masochistic component should be mentioned. This is the need to hurt others, and the need to be hurt by others. When a woman in the office makes a repeated error, she is asking for control. She wishes you to show that you are the man in the situation. If she ought to be bawled out a bit and it is not forthcoming, then you have another problem situation coming.

The extreme woman in this situation marries an alcoholic and goads him when he is drinking so that he beats her. She has him jailed and then comes to the court and pleads to get him out—for another round. The sadistic woman would handle the matter by setting up booby traps and then sweetly denying that she understood she was causing a problem. The female in our society likes more to be hurt and the male likes more to hurt others.

Guilt—Guilt as we see it in our society is based upon the knowledge that one has made an error or has done something wrong. We believe that what we sow, we reap and, thus, wrongdoing is taken care of by punishment. For practical purposes, this means if a person feels he has done something wrong, you do him a service to extract some punishment for it. This relieves the guilt, evens the score. It must be admitted frankly that we often feel guilty far beyond the value of the error.

Ogden Nash wittily and wisely wrote a poem on remorse, the theme of which was that "remorse is a duffer, the wrong people suffer." He observes that "the only person in the coliseum whom remorse enveloped like an affinity was the martyr who had slept through the sermon on the second Sunday after Trinity."

The problem of guilt, when it is present, is that if it is not expiated by punishment, it will seek to find the expiation, usually by a more extreme error, unconsciously designed to bring vengeance from an outside source. An accident, an injury, is an excellent means of accomplishing this.

It is equally important to recognize that, when a person should be expected to show guilt and does not, there should be a suspicion that the situation involving the error, or accident, was not a chance matter. I will never forget an interview with a truck driver who had killed three persons in an accident he could have avoided by yielding the right of way. "I always get mad at the people who try to cross the highway there and don't stop." It looked as if he had decided that it was open season on anyone who didn't stop. He showed no signs of tension, anxiety, concern, self-consciousness or guilt. Not even compassion for the persons concerned was expressed. The lack of guilt is diagnostic of strong hostility in the accident and may indicate either deliberate involvement or unconscious involvement.

Wish To Die—The wish to die is a motive which should be discussed here, thereby raising the question of the possibility that suicide may occur in the plant or on the highway. This material has important implications, and is little understood.

Concern for the wish to die as a motive in accidents was aroused when a disturbed father asked for counsel when his small son was depressed. The boy had lost his dog when it was run over by a truck two weeks earlier. The child reasoned this way: "My grandmother died a year ago and went to Heaven. Spot was killed by a truck and he went to Heaven. If I run under a truck on the state road, I can go to see Spot!" The implication is clear. What would look like driving to endanger and manslaughter on the part of the driver would in fact be suicide on the part of the child.

In one case, a man who walked in front of a car and was killed was shown at autopsy by Dr. Richard Ford, Harvard pathologist, to be studded with peritoneal carcinomatosis which had been discovered in the pancreas three years earlier. The case was now going sour and death was a few weeks or a few months away. Suicide here is hypothesis.

But take the case of the man who threw himself under the rear wheels of a trailer after the tractor had passed at low speed. A driver following urged the truck driver to question the injured man as to his motives. He admitted attempting suicide and made a second admission in the hospital just before he died.

When you see a man lying dead on the ground near an electrical substation, his hands badly burned and his gloves resting on a meter, it is important to raise the question of how the death came about.

Is it an accident or is it suicide? (See Figure 4.) Studies of fatal accidents currently underway at Harvard Medical School's Department of Legal Medicine now show, in the suicide category, nine cases in the highway series, one rail case and two possible industrial cases.

It is not necessary to expand details in order to establish this phenomenon. It is urgent to present the fundamental reasoning to which it is related. The basic psychological and psychiatric problem of the wish to die, as expressed in the accident scene, is the deliberate involvement of another person in the production of the suicide. I admit freely that I have no understanding of this. It is important for any worker or driver to realize that another person may victimize him during suicide. The motorist should be aware not only that pedestrians take risks but also the ends to which the risk-taking behavior may go. This is especially important when you realize the implications of a manslaughter charge, the loss of license and the liability suits that follow.

It must be faced also that suicides in auto and industrial situations may be motivated by the desire to collect double indemnity for accidental death. A finding of carcinomatosis at autopsy is not *prima facie* evidence of suicide, no matter how suggestive it may be. And depression is not discernible at autopsy.

Presentation of this material is predicated on the assumption that he who intends to commit suicide may be expected to do it anyhow. We perhaps are not writing the script, choosing the players and opening the curtain for the dramatic event. The possibility of triggering an epidemic of such cases is a real one. We have no way of knowing how many such cases there are now and identifying the phenomenon may lead to better observations. There certainly is an important problem here for the investigator and the educator and the ethicist. I present this material with full awareness of its seriousness but also with awareness of the necessity for communicating it to those whose professional responsibility must encompass it.

Secondary Gain—Secondary gain is a psychological factor which is observable in many aspects of life. A habit or attitude or practice may be wholly negative in the way it operates in personality and yet offer secondary gains which so far outweigh the disvalues of the situation that the negative situation is acceptable.

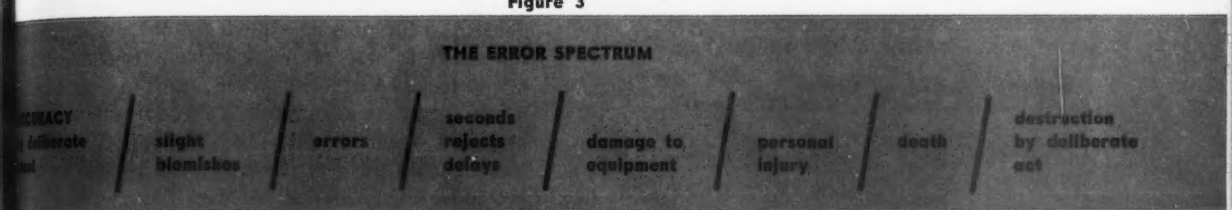
For example, the homosexual male marries a wife —and is offered protection from being identified for what he is. The look of satisfactory adjustment to adult life outweighs the pain of being under the same roof with a woman. The child who enjoys a band-aid on his leg may fall and plead injury in order to have the attractive adhesive attached to his skin. The plain girl in the office whose hand is in a cast was never noticed until she stumbled over an open file drawer. Now everyone asks her every day how her hand is. Some act in small ways as if she were their boss, and they, the assistant.

Also, you see the situation in which facing a disagreeable situation or task is one for which the person cannot muster the strength. As you pull the injured lady out of the badly damaged vehicle to take her to the hospital, you hear her saying, "I didn't want to go to work today."

Finally, there are many people who will do almost anything for money. Some even will go so far as to actually be in, and injured in, the accident they report.

I have mentioned four basic factors, the sadistic-masochistic component, guilt, the wish to die and secondary gains. How can these be managed? They can be managed at a basic level by continuing character education, by support of good family life and by sensible exchange on the part of those whose role in safety is appropriate. When the sadistic-masochistic component is active, the worker is asking for control. Do not deny him the security that control gives. When guilt must be expiated, extract a penalty. When the wish to die begins to emerge enough to be idntified, quickly get professional psychiatric help. The tendency of most people everywhere is to deny that these tendencies exist. Some accidents produce

Figure 3



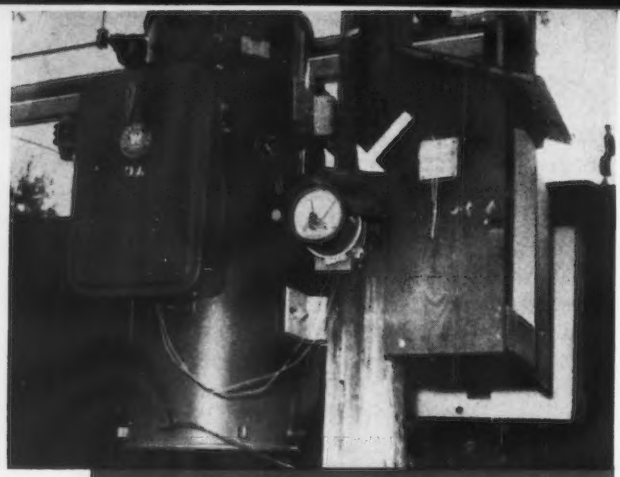


Figure 4—Story of the ungloved hands: gloves are resting on equipment (see above) and below on the ground lies the dead lineman who had taken gloves off while working. He knew the danger; is this suicide?

motives related to safety *continued*

a secondary gain by taking the profit out of the accident.

ENGINEERING APPROACH OFFERS PROTECTION

I have said on many occasions that people decide what rules they will break and what rules they will keep. I also have expressed the principle that the factor of being for and against something is present in the same person at the same time. Here is an engineer who was killed while jaywalking, who was a rough-rider on grounding all electrical equipment. He started by using cross walks, and one day his mother or father led him across the street from between parked cars. He didn't get killed nor even injured. The teacher is obviously wrong: the fact that he often got away with it was clear evidence that it was safe.

In the case of the man who took off his gloves to work, meanwhile touching a high tension line and being killed, another worker was with him. Police and others were summoned quickly. No attempt was made by any person to apply artifical respiration by any method. Certainly this man might have been seriously injured by the fall, but he would have had a 50-50 chance of survival if respiration had been reinstated immediately.

The engineering implications of this case are simply that the design of the equipment is not such as to make manual manipulation easy or comfortable while using protective equipment. Thus, the design encourages taking off the protective gloves. The use of full scale mockups and advance should be routine procedures.

I am often impressed with the extent to which people complain that autos are unsafe and yet assume they know everything about what is good and bad equipment and, particularly, about when a seat belt in a vehicle offers no assistance. Many traffic deaths in 1958 involved an eight or nine year old automobile being driven without any protective equipment. You certainly would consider it regrettable to have a child with diagnosed pneumonia treated unsuccessfully with aspirin in 1958, when penicillin would save his life. We are in the same situation in motor vehicle deaths when we operate automobiles without certain protective equipment.

Here is a survivable crash. Two occupants are still alive. The third, mother of a two week old infant, was thrown from the vehicle and was killed. When you observe the vehicle you find little external damage. Even the windshield is intact. There is little damage in the passenger area. An autopsy explains the death as due to multiple basal fractures and hemorrhages. Seat belts would have prevented this death. As I have said, we decide which rules we will keep and which we will break. Undoubtedly no one today should push his luck by refusing the use of protective equipment in his car. The one time he may need it, it must be there and in use.

A final point I wish to make is that the task of the educator and the engineer is made much easier if the factual nature of problems is known. This is particularly important in cases involving the loss of life. Deaths on the highway, in air accidents and in industry are of public interest and should be investigated by all techniques. Among these should be autopsy in order to establish cause of death. The action of toxic agents, heart disease, epilepsy, cerebral vascular accidents and other factors is very important to establish, for control programs based on opinions, without factual evidence, may be wrong.

CONCLUSION

In discussing motives in relation to safety, it is important to be aware of motives which lead to correct responses and safe acts and to identify motives which lead to incorrect responses and unsafe acts. Once these positive and negative motives are identified, it is important to understand how they came to be, what can be done to reinforce positive motives and what can be done to undermine or replace negative ones. The engineer must be aware that the most highly organized motivational system is subject to failure, the best habits may not function and the best attitudes may be disrupted. The engineer must be concerned with the conditions under which both men and machines are subject to failure and attempt to provide engineering protection for those occasions.

AN ENGINEERING APPROACH TO SAFETY IN MATERIALS HANDLING

BY WALTER J. BYRNE

THE HANDLING OF MATERIALS is an integral and important phase of practically every business enterprise. But, despite the fact that great strides have been made in improving handling techniques in many industries during the last three decades, this segment of operations still accounts for one of industry's biggest cost items. Quoting reliable statistics, about 20 to 25 per cent of all labor hours goes into some form of handling. This considerable expense item becomes all the more impressive when it is recognized that, as often has been said, "materials handling adds nothing to the value of a product."

In the opinion of many management authorities, this improvement drag has been caused by a lack of appreciation for the problem and a lack of accurate cost data pertaining to it. For the progress that has been made to date, the major credit, it would appear, rightfully should be assigned to the research and development of the materials handling equipment manufacturers themselves. It would seem that an ingredient currently required is a greater effort on the part of individual business concerns to explore their own operations with the view to eliminating deficient methods and practices and adopting more efficient procedures.

PRINCIPAL SOURCE OF WORK ACCIDENTS

The handling of materials is the principal single source of work accidents and injuries in American industry. Again quoting from reliable records, 25 per cent of all job injuries stem from some form of materials handling.

Despite great strides made in the last few decades in the broad field of industrial accident prevention, materials handling accidents and injuries are a recurring problem. Could it not be that the same reasons that apply to the efficiency lag also may be assigned to the safety lag in materials handling?

In tracing the evolution of management to its present day form, its development can be broken down into three fundamental periods — rule-of-thumb, systematic and scientific. Following the Industrial Revolution of the Seventeenth Century and the beginnings of the transfer of skill from men to machines, factory managers operated on hunches and inspirations. Because the demand for goods was so great, rule-of-thumb judgments sufficed, with the resulting numerous mistakes being readily absorbed.

As individual enterprises grew in size and complexity, supply caught up with demand and competition commenced to show itself. Of necessity, the rule-of-thumb management was replaced by a so-called "systematic" procedure, in which methods and practices which seemed to have worked well in the past were standardized. Although a step forward, this technique was systematic only in so far as it tried to reduce a set of practices that had proved successful in the past to a routine for dealing with operations of a recurring nature.

MANAGEMENT ADOPTS SCIENTIFIC METHOD

Some 60 to 70 years ago, Frederick Taylor entered the scene and introduced the beginnings of scientific management to business. His approach

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FIGURE 1—FLOW PROCESS CHART FOR METAL WORKING CONCERN

PARTIAL CYCLE—ORIGINAL METHOD

ACTIVITY SYMBOL	DISTANCE	ACTIVITY DESCRIPTION
O-1		Packs sheet steel, 12" x 12" x 6", 200 lb each, unloaded by two wheel hand trucks from trailer by driver and helper onto loading platform. Material handlers (2) load packs onto skid, 12 to skid.
T-1	150'	Skids transported by hand jack truck to warehouse.
O-2		Skid unloaded by two men, packs stacked three high on floor.
PS		Await production requisition.
O-3		Six packs loaded on skid, two men.
T-2	200'	Transported by jack truck to Press #6.
O-4		Material handler, assisted by press operator, unloads packs onto floor.
O-5		Operator breaks open packs and handles individual pieces to completion.

PARTIAL CYCLE—REVISED METHOD

ACTIVITY SYMBOL	DISTANCE	ACTIVITY DESCRIPTION
		Packs sheet steel, 12" x 12" x 6", 200 lb ea unloaded from trailer truck by driver helper onto 48" pallets supplied by Recei nine to pallet. Roller conveyor also available for transport from truck to tailgate.
T-1	150'	Lift truck transports to warehouse and re some.
PS		Await requisition.
T-2	200'	Loaded pallet transported to Press #6, by truck, placed on 3' high bench beside machi
O-1		Operator breaks open six packs and ha individual pieces to completion.
T-3	200'	Lift truck returns three pack pallet load warehouse.

safety in materials handling *continued*

was to look behind those methods and practices which appeared to bring about desired results, in order to find what laws and principles, if any, were operating. While the systematic method asked the question, "What practices have worked in the past?" the scientific approach asks, "Why do some practices work out and others fail?"

A recognized aim of a good industrial safety program is to "build in" accident prevention measures, both in work procedures and physical facilities, and thus greatly minimize the unpredictable human factor inherent in all of us. Present day machine guarding and dust and fume control are examples of successful, built-in safeguards.

In the field of materials handling, the achievement of built-in controls has been spotty. Despite the ever increasing use of mechanical aids such as lift trucks, cranes and conveyors as a means of bypassing manual "muscle moving," hazards and injuries from this source remain numerous.

All of us are aware that an important and necessary ingredient in arriving at any solution is an accurate spelling out of the problem in question. In this connection, the writer finds himself continually focusing his attention on the strict meaning of an industrial accident involving materials handling.

As generally defined, an accident is an unexpected happening which may result in personal injury, property damage or both. When one examines closely materials handling incidents, is it not realistic to classify certain so-called work accidents as work injuries—not as unexpected, but rather as *inherent* in the job procedures being followed?

Most competent observers attribute the primary cause of materials handling accidents to personal actions under such specific headings as "Unsafe Habits," "Improper Lifting," etc. Safety people work long and hard, trying to come up with more effective means of educating individual workers in safe handling methods. Despite numerous recognized successes here, many efforts are doomed to failure on a long range basis. This suggests to the writer that a reexamination, considering both hazard and inherent injury potential, is called for. And Taylor's fact-finding and analysis techniques seem to provide the most effective means for carrying out this study.

USE OF OTHER STAFF SPECIALISTS

In considering this undertaking, it is realized that a safety engineer is primarily a coordinator of accident prevention activities and not an individual

who knows all the answers to everything. Where firms already employ staff specialists in such areas as methods and time study, is it not reasonable for the safety coordinator to present the fact-finding and analysis assignment to them?

In any event, perhaps it is time for many safety engineers to break out of certain confining wraps, concerning their activities and responsibilities within the organizational framework of their companies, and take a more aggressive interest in methods, particularly as they apply to materials handling. In this connection, a review of process charts, layouts and individual operational studies, plus a questioning attitude—all tools borrowed from methods engineers—is presented in this article.

PROCEDURES FOR FACT-FINDING

The flow process chart is a written record or charting of a materials handling cycle, calling for data on the material to be handled, the methods of handling and transport, the distances moved and similar information pertinent to the problem. The scope of individual cycles naturally will vary with the type of industry involved and its complexity. *(See Fig. 1.)*

In a product manufacturing layout, where the various machines and equipment utilized are placed in connecting sequence (i. e., a chemical operation or a bakery), it is feasible to chart the handling and transport of individual materials from their point of receipt as raw materials to their shipment as finished products.

In a process manufacturing layout, where similar machines and equipment are grouped in departments (i.e., a machine shop), it is preferable to record the handling activity in three separate stages:

1. Raw material and purchased finished part handling, transport and storage.
2. Materials-in-process handling, transport and storage.
3. Finished product handling, transport, storage and shipment.

Coincident with process charts, layouts of the arrangement of production machinery, work centers and auxiliary activities provide means of tracing the physical route of materials and identifying the adequateness of available space.

The individual operational study focuses on the recording of the handling requirements of machine and equipment operators, fabricators, assemblers and materials handlers themselves. While it is admitted that the recording of such operational data in even the smallest company can be extensive, the procedure is simplified greatly, with little loss of thoroughness, by breaking down similar handling routines into a reasonable number of groupings or classifications. *(See Fig 2.)*

Those who have engaged in surveys of any type of business procedure undoubtedly have learned that quick and easy analyses are conspicuous in their incompleteness. The quest for safety in materials handling is no exception; there is no miraculous, overnight cure.

The work involved in compiling written fact-finding records, however, need not be an overwhelming task. Detailed handling data associated with one commodity can be effectively applied to all similar situations. In a paint manufacturing concern, the handling of a drum of one chemical would be employable for analysis of other drum chemicals in similar usage. Recorded data on the handling of small, medium and large castings would have wide, recurring application at turret lathes, milling machines and drill presses.

QUESTIONS TO USE IN ANALYSIS

The gathering and recording of operational data is followed by the analysis phase. Most simply defined, this is a testing out of actual procedures by

FIGURE 2—INDIVIDUAL OPERATIONAL STUDY FOR SMALL WHOLESALE BREAD BAKERY

FLOUR BLENDING—ORIGINAL METHOD

Bags of flour are stacked on floor in the area adjacent to the blending machine. Operator walks 15 feet to 20 feet, picks up 100-pound bag of flour A at storage pile, carries back to machine, sets down, slits bag, lifts four feet to hopper opening, empties. Repeats three additional times with flour A, two times with flour B to complete cycle.

FLOUR BLENDING—REVISED METHOD

Small lift truck and supply pallets acquired. Screw conveyor installed at machine, enabling hopper opening to be lowered to six inches above floor. Bags of flour palletized on receipt, transported and stacked by lift truck in blending area. As required, pallet loads of flour A and B moved to hopper opening by lift truck. Operator drags bags off pallets, slits, empties into hopper opening at floor level. (No actual lifting off floor required.)

a series of pertinent questions aimed at isolating potential injury producing conditions. Suggested questions, some of which overlap for greater assurance of completeness, are as follows:

1. Can the handling operation be eliminated in whole or in part? If a "don't touch" idea is applied diligently and open mindedly, the results may be most fruitful. An important axiom of efficient materials handling often has stated as: "Efficiency in moving materials is best obtained by *not* handling them."
2. Can the handling operation, assuming it is a required one, be carried out in a simpler, safe manner?
3. Does the handling operation call for the transfer of materials from the floor to a conveyance, or vice versa?
4. Are work places so arranged as to require machine and equipment operators and assemblers to do a considerable amount of manual lifting, bending, stretching and positioning in connection with the materials they work with?
5. Concerning individual materials or unitized packages of same which must be manually lifted, are the weights within a reasonable range? Is the added problem of a required positioning element, coupled with a manual lift, taken into account? Are the limitations of female workers allowed for? Where time study is used, do the standards allow for (and enforce the use of) crane time at prescribed weight limits?
6. Are all dangerous properties of the materials themselves accounted for?
7. Are raw materials, materials-in-process and finished parts and products stored in neat, stable piles? Is ease in rehandling taken into account?
8. Are materials of different types, sizes and shapes segregated so as to insure a minimum of reshuffling?
9. Does the plant layout consider adequate storage areas in both warehouse and production areas as necessary adjuncts to efficient and safe operation?
10. Are definite routes of travel established and sufficient unobstructed aisle space available so as to avoid congestion and uncontrolled movement of materials handling equipment?
11. Are overhead cranes, lift trucks and other mechanized handling equipment of sufficient capacity to safely sustain the loads to be applied?
12. Does a preventive maintenance program insure the continued availability of sound equipment?
13. Are employes well grounded in safe handling methods of a routine nature? Are special instructions given employes as to safe handling methods of a nonrecurring nature? Is protective apparel (gloves, safety shoes, etc.) required where potentially hazardous conditions exist?

As these and other pertinent questions are asked about every step in the materials handling process, safety deficiencies evolve. No single handling category can fail to benefit from such a survey.

Underlying all of the foregoing fact-finding and analysis procedure is work simplification, utilizing the well known and oft repeated guiding principle, "The best way is the easiest and safest way."

INCLUDE ACCIDENT ANALYSIS, CLAIM COSTS

In the development and accumulation of the pertinent questions required to test out handling procedures, an analysis of past accidents is invaluable. The worth of the analysis, however, is in direct proportion to the relevance of the accident cause classifications used. It has been this writer's experience that many accident cause classifications have been misleading, almost to the extent that they were unusable. Therefore, it is urged that such data receive careful consideration so that meaningful cause classifications can be established.

A further related subject—pertinent to any organized industrial safety plan—which should be considered, the writer believes, is the item of compensation claim costs. Safety people long have based accident prevention performance on frequency and severity, particularly the former. The true meaning of these statistics is known mainly to the safety people themselves. It is felt that the higher eschelons of management would be much more amenable to and appreciative of safety efforts if claim costs were to be included. Realistically speaking, also, the growing trend toward permanent partial disability awards on nondisabling injuries has watered down greatly the significance of frequency data.

CONCLUSIONS

It is impossible to examine the American industrial scene for long without coming to the conclusion that management is smarter than ever before. This is as it should be. It is evidence of progress. Perhaps it explains in part why one often hears the complaint that it gets harder and harder to compete. Thus, the theme for greater efficiency becomes "Continuing Dissatisfaction."

The best executives usually are those who won't ever admit that everything is going as well as it should. Generally speaking, this may not be a happy frame of mind but it most certainly leads to progress.

Perhaps safety people should enthusiastically embrace "Continuing Dissatisfaction" as respects materials handling. The writer believes that fact-finding and analysis is a blueprint to point the way.

methods and procedures in a MULTI-PLANT safety program

BY JAMES W. TYSSE

SAFETY IS AN ALL HANDS JOB and those charged with safety in an industrial operation must realize this fully. They must be aware of the importance of a sound safety program and, also, of the psychology of safety: the need for awakening in every man in a plant the realization that he himself can make an important contribution to his own safety and that of his fellow workers.

At Republic Steel Corporation a multi-plant safety program, in which the writer has participated, has been carefully worked out. Over the years since its inception, frequency and severity rates have been achieved which usually have been better than the average for the industry.

Basic to the planning for this program has been the constant realization that everyone in every plant must be given a sense of participation in the program, with an accompanying awareneses of his own personal responsibility in it.

MANY HELP PLAN PROGRAM

The development of the program has been the work of many minds. The basic structure was established in the early days of the corporation; it has been refined and adapted to changing conditions since but is fundamentally the same today.

A primary consideration in the planning, of course, was the establishment of policies and regulations—consistent with local, state and federal requirements—which could be followed by all plants. These policies and regulations were compiled into a book called *Manual Governing Medical, Workmen's Compensation and Safety Procedure.*

Over the years the book has grown until today it contains 92 pages, giving explicit instructions to safety and operating people. As its title implies, it is divided into three main sections; however, this discussion is limited to the section on safety and the guideposts it supplies for reducing or eliminating accidents.

THREE FACTORS BASIC TO "OPERATION CAP"

Before taking up the subject of the manual in detail, I should like to point out a few principles that we established at Republic for our 1958 safety program, "Operation CAP"—the initials being stressed as meaning *your* Contribution to Accident Prevention. "Operation CAP" was premised on three factors—a basic program, an objective and good communications. The program spotlighted safety performance for top plant management. Any strictly local plans could be coordinated readily into the overall corporate program.

The objective was for each district to better its own top performance in frequency and severity, as recorded during the preceding six years, 1952-1957.

Under communications, we set forth explicit instructions for teletyping or telegraphing immediately to the general office notification of any disabling injury, including a brief description of the accident and the apparent cause. This was relayed immediately to safety people and superintendents of industrial relations. In the event of serious or fatal accidents, the communications described above were preceded by a telephone report.

How did this work out? Fairly well. While performance wasn't all that was hoped for, how many safety records ever meet with the approval of a

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safety man? Significant results were experienced in a number of plants.

That is a very brief picture of Republic's 1958 safety program. Now I should like to review some of the specific points of our manual.

MANUAL OUTLINES COMMITTEE STRUCTURE

The manual calls for the establishment of three basic safety committees throughout the corporation: a Corporation General Safety Committee, plant general safety committees and departmental safety committees. In addition, corporation operating committees assign safety subcommittees and the subject is number one on the agenda in their scheduled meetings.

The Corporation General Safety Committee is composed of the director and assistant director of industrial relations, the manager of safety, all district or plant superintendents of industrial relations, the director of plant protection and the manager of workmen's compensation and social insurance. It serves as adviser on all matters pertaining to accident prevention, workmen's compensation, good housekeeping, fire prevention, etc.

A plant general safety committee consists of the district or plant manager and his assistant, the superintendent of industrial relations and his assistant, the supervisor of safety, the fire marshal and all department heads. It meets monthly to discuss all phases of safety, fire prevention and good housekeeping; it formulates plant safety policies and recommends safety rules and measures.

DEPARTMENTS MUST MEET MONTHLY

The departmental safety committee includes the superintendent, his assistant, all of the department's foremen and, in an advisory capacity, a Safety Department man. Such committees must meet at least once a month. Also, each foreman or assistant foreman is required, monthly, to hold at least one safety meeting or discuss safety personally with each employe under his supervision.

The manual also provides for establishment of an accident investigating committee in each plant and outlines procedures. In addition, subcommittees of corporation operating committees immediately investigate serious accidents and formulate preventive measures which become committee policy.

The manual encourages close cooperation between local engineering and safety departments on all matters pertaining to safety, especially in any new or changed installations being contemplated. Also, the manual emphasizes the importance of making routine health surveys. And it provides for a rehabilitation committee to place employes disabled in previous accidents on jobs they can perform.

Occasionally, changes or additions to the safety program are made and these are incorporated into the manual by reference—for example, the monthly poster and leaflet program which was started in 1948. Under this program, the Safety Department each month selects a subject for development by an advertising firm. Billboard and bulletin board posters are printed for display in all plants and safety leaflets are prepared and distributed to employes.

After the establishment of general policy on safety, the manual devotes a large section to the required general and special reports, such as Unsafe Practice, Fire Extinguisher, Foreman's and Weekly Accident Reports and inspection reports for ladles, chains, cranes, ore bridges, turbines, fly wheels, air receivers, etc. A number of these reports call for appointment of district or plant committees to make inspections and submit their findings and recommendations periodically.

A section on references to the general safety orders and special rule books concludes the manual. Mention also is made of procedures for providing information about accidents to newspapers.

PUBLISH GENERAL ORDERS SEPARATELY

The general safety orders and special rule books which I mentioned above are listed in a separate book, which also contains provisions for current meeting material, foremen's instruction sheets and the district safety orders made up in various districts or plants to cover special local conditions.

Basically, this is the planned safety program of Republic Steel Corporation. It is administered through and by the Industrial Relations Department, with direction and supervision at both the general office and plant levels.

To insure adherence, each facility is inspected thoroughly at least twice a year by representatives from the corporation's General Safety Office, who check all matters pertaining to local administration of the program and advise on improvements.

Each district or plant manager is held responsible for safety in his own operation. Usually, the safety results achieved are in direct ratio to the manager's interest in the program. We have found that safety is more than just following the book. A good program frequently includes elements which are above and beyond the basic principles. These include diversifying educational techniques and, in general, advertising and selling the importance of safety as a program of mutual benefit to everyone.

BY ROBERT J. DOUGHERTY

SAFETY'S FUTURE: BREAKTHROUGH!

present methods have produced excellent results but different weapons are necessary to future advances in the war against accidents

GREAT STRIDES HAVE BEEN MADE, to date, to prevent the wasteful loss of human life, the unnecessary personal suffering and the neglectful destruction of property due to accidents.

Government and private industry for the most part have acknowledged their responsibilities in this respect and are doing outstanding jobs. From top management down to the supervisor, a chain of command is functioning to get across the safety message to the employe. A great attack on accidents has been going on for many years and not without results.

But the time is at hand when we must discard the tired, worn out campaign banners—"We must educate the employe in safe practices," "We must design guards on our machines," "We must have management support." These banners have led us to many victories; however, generally speaking, they apply now to battles that have been fought and won —only a few guerilla fighters remain.

NEED NEW PLANS TO AVOID STALEMATE

While all current safety activities should be continued to mop up these lone snipers and to maintain a constant patrol against new outbreaks along the presently established accident front, we now need some new banners and some new battle plans to help us advance our fight substantially. We must, indeed, effect a major breakthrough to carry on our safety crusade, else we soon will be confronted with a war that has reached a stalemate.

We must regroup and retrain our forces. Through hand to hand combat we have won the day against mechanical failure; we have been victorious in enforcement of safety rules, in use of visual aids and in employe training; we even have advanced on the field of traffic safety, as far as possible by hand to hand combat.

But the battle of the ages—the most difficult of all—has yet to be fought. The majority of accidents today are caused by people—people who, as individuals, have not been able to understand, accept and act on the premise that each of us must be seriously concerned with preventing injuries to ourselves, that our own lives and welfare, our most important personal considerations, are at stake.

MUST REACH HEART AND MIND OF NATION

To win on this personal front, we need the most modern methods available. We in safety must conduct a full scale "warm war"—a war that will hit every heart and mind in the nation.

Today a vast amount of industrial safety ammunition comes to the average employe from his employer. What is being given to him is good, but entirely too much is coming from the same direction.

In our national safety programs, on the other hand, we have been fighting on too small a scale, mainly in traffic and home safety. The attack must be

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broadened to include industrial safety, with our sights taken off management and supervisors and turned on John Doe, the individual.

As individuals, we find it very difficult to see "what's in it for me" when the bulk of industrial safety is coming at us from one direction, our employer. The only way to win for safety is from behind the enemy lines, through infiltration.

We need campaigns nationally that actually reach all Americans. One might say, "It can't be done." But national campaigns have placed Elvis Presley and Burma Shave in the minds of almost everyone in the country. We have all the "know how" necessary for this kind of program. All we have to do is aim our weapons straight to John Doe, the individual, everywhere he is found. We need to bombard him from his TV set, the newspaper or magazine he reads, his radio set, the movie screen and every other medium of communications. All of this can be done in a manner both factual and entertaining—perhaps we might call it a sneak attack.

OUTLINES THREE POINT ATTACK PLAN

How is this to be accomplished and by whom? A natural outlet would be a special division added to the National Safety Council, devoted specifically to intelligent advertising of *industrial* safety—not only spot announcements of safety on TV and radio and a bombardment of safety slogans, but concentrated, down to earth "John Doe style" material. The following is a thumbnail index of what the writer feels needs to de done:

1. Human interest articles, factual in nature and related to safety, should be requested from all members of the American Society of Safety Engineers. This should provide a backlog of material that, skillfully rewritten, could be submitted to popular general magazines such as Reader's Digest, Coronet, Look, Life, This Week, Saturday Evening Post, etc., as well as the leading magazines for women and religious and union publications. Perhaps magazines which carry monthly health articles also could be sold on a monthly safety article.

2. Television scripts with an action-packed human interest story, related directly or indirectly to safety, should be written for the various playhouse type programs and sold to sponsors. If emotional programs can be built around doctors, ministers and gangsters, then certainly an excellent series could be built around industrial accident prevention specialists. There is nothing more emotional or dramatic than the devastation wrought by accidents: dreams shattered, promising careers snuffed out, once prosperous families left destitute.

It also is true that many feature movies have been made about the medical profession and its members, as well as about lawyers, scientists and others with professional status. It is time to sell the motion picture industry on the idea of a humanitarian move based on the safety profession.

3. Paid safety advertisements should be placed frequently in such magazines as are normally found in the average household. Monsanto's informational messages on laminated safety glass, which have been appearing in Reader's Digest, are the type of safety advertisements needed for industrial safety, I believe. Some magazines may carry such material as a public service. Perhaps other ads could be paid for by small contributions from private industry. Some industrial firms and insurance companies might sponsor individual ads.

Would such articles, ads and dramas be effective? Reader's Digest alone has 35,000,000 readers—that's a lot of John Does. Results? An article on health in this magazine some time ago merely mentioned that smoking may be a contributor to cancer. No actual facts were given to prove this completely; only a relationship was shown. Yet, many thousands who read the article either cut down, changed to filter tips or cut out smoking entirely. Many of these same people had been told previously by their own doctors, often for more immediate and compelling reasons, to cut down or quit smoking but had ignored the advice.

Why, then, was the article so effective? Simply because people read it for themselves and thereby became satisfied that their doctors had known all along what was best for them.

WILL SELL WORKERS ON PLANT PROTECTION

If more workers, and their families, could read for themselves, in general circulation publications, comparable material on safety, accidents caused by personal inattention would be reduced greatly. I believe that these workers would put the safety instructions of their employers into action as never before—not because the employers said so, but because one of their favorite magazines (or movies or TV shows) implied that these people should think of their own safety.

It's our job, as professional safety specialists, to see that our product is put into a package that will sell John Doe, the individual. We need a national industrial safety program.

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Membership Information

THE American Society of Safety Engineers has established the following classifications of active membership.

MEMBER — To be eligible as a Member an applicant shall be at least thirty years of age and shall be engaged in safety engineering. In addition, he shall have either an engineering or science degree in an accredited college curriculum and the equivalent of eight full years' experience in safety engineering; or he shall have had the equivalent of ten full years' experience in safety engineering.

ASSOCIATE MEMBER — To be eligible as an Associate Member an applicant shall be at least twenty-five years of age and shall be engaged in safety engineering. In addition, he shall have either an engineering or science degree in an accredited college curriculum and the equivalent of three full years' experience in safety engineering; or he shall have the equivalent of five full years' experience in safety engineering; or he shall have either an engineering or science degree in an accredited college curriculum, ten years' experience in professional engineering work and one full year's experience in safety engineering; or he shall have twenty years' experience in engineering work, of which at least ten have been at the professional level, and one full year's experience in safety engineering.

JUNIOR MEMBER — To be eligible as a Junior Member an applicant shall be at least twenty years of age and shall be engaged in safety engineering work, which if pursued the required time will tend to qualify the applicant for the classification of Associate Member. In addition, he shall have either an engineering or science degree in an accredited college curriculum or he shall have had the equivalent of one full year's experience in safety engineering.

AFFILIATE MEMBER — The Society also provides a special classification, that of Affiliate Member, for those not professionally engaged in safety engineering. To be eligible as an Affiliate Member an applicant shall be at least twenty-five years of age and shall have contributed to the advancement of safety engineering through demonstrated achievement in some related field of interest in which he has been engaged for at least three years.

for additional information write to

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